## WHAT IS CLAIMED IS:

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1. Apparatus for detecting fluorescently marked regions on a substrate, said apparatus comprising:

a light source;

an optical train for directing a light from said light source at said substrate;

means for focusing said light on a surface of said substrate;

means for detecting a fluorescent emissions from said fluorescently marked regions in response to said light;

means for translating said substrate from a first position to a second position; and

means for storing a set of values representing an intensity of said fluoresced light, said intensity being a function of the location of said substrate.

- 2. Apparatus as recited in claim 1 further comprising a video display means for displaying said values representing the intensity of said fluoresced light as a function of location of said substrate.
- 3. Apparatus as recited in claim 1 wherein said optical train comprises:
- a spatial filter comprising of a first and a second lens and a confocal pinhole located between said first and said second lens;
  - a beam splitter cube;
- a dichroic mirror for passing light having a

  wavelength of about said fluorescence emissions and reflecting
  light having a wavelength of about said light;

an optical lens; and

a microscope objective for directing said light at said substrate.

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4. Apparatus as recited in claim 1 wherein said focusing means comprises:

- a photodiode for generating a voltage representing an intensity of said light reflected from said substrate; and
- a focusing lens for focusing said reflected light from said optical train at said photodiode;
- means for moving said substrate relative to a microscope objective until said light detected from said substrate substantially reaches a maximum.
- 5. Apparatus as recited in claim 4 wherein a confocal pinhole is located between said focusing lens and said photodiode.
  - 6. Apparatus as recited in claim 1 wherein said detecting means comprises:
    - a photomultiplier tube; and

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- a lens for focusing said fluorescent emissions collected by said optical train at said photomultiplier tube.
- Apparatus as recited in claim 6 wherein a
   confocal pinhole is located between said focusing lens and said photodiode.
  - 8. Apparatus as recited in claim 6 wherein said photomultiplier tube is couple to a means for collecting pulses generated by said photomultiplier tube in response to an intensity of said fluorescent emissions, said means for collecting pulses connected to a programmable computer for storing and analyzing said pulses.
- 9. Apparatus as recited in claim 1 wherein said translating and said focusing means comprise a x-y-z translation table, a flow cell mounted on said x-y-z translation table, said flow cell comprising a mounting surface with a cavity therein, said mounting surface comprises means for mounting said substrate thereon and maintaining a sealed relationship with said substrate, said cavity comprises an inlet and an outlet, and said inlet connected to a pump for

transferring materials into said cavity and out through said outlet.

- 10. An apparatus as recited in claim 9, further 5 comprising means for controlling temperature in said flow cell, said means for controlling temperature including a recirculating bath device for circulating water through channels disposed in said flow cell.
- 10 11. An apparatus comprising:

a light source;

an optical train for directing light from said light source at a substrate including a surface having fluorescently marked regions;

a translation system co-operatively arranged with said optical train and constructed to support and displace said substrate;

an auto-focusing system constructed and arranged to focus said directed light onto said surface;

a detector for detecting fluorescent light from said fluorescently marked regions of said surface in response to said light; and

a computer arranged to control operation of said light source, said detector, said translation system and said auto-focusing system to execute auto-focusing by controlling said translation system and bringing into focus corners of said surface; said computer being further arranged to receive data from said detector corresponding to said detected fluorescent light and provide a data file representing an array of photon counts as a function of a pixel position on said surface.

12. The apparatus of claim 11, wherein said computer is further arranged to generate an image file including data indicative of fluorescence intensity level as a function of said substrate pixel position.

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- 13. The apparatus of claim 11, wherein said detector comprises a confocal detector including a pinhole.
- 14. The apparatus of claim 11, wherein said detector 10 comprises a photodiode utilized for said auto-focusing and a photomultiplier for detecting said fluorescent light.
- 15. The apparatus of claim 11, wherein said computer executes said auto-focusing by interpolating focusing values determined for said corners of said surface having a planar shape.
- 16. The apparatus of claim 11, wherein said computer executes said auto-focusing by bringing into focus all four of said corners of said surface.
  - 17. The apparatus of claim 16, wherein said computer executes said auto-focusing by interpolating focusing values determined for said four corners of said surface having a planar shape.
  - 18. The apparatus of claim 11, wherein said translation system includes an x-y-z- translation stage.
- 19. The apparatus of claim 11, wherein said optical train separates reflected excitation light from said surface of said substrate from fluoresced light from said surface.

20. An apparatus comprising:

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- a light source constructed to emit excitation light;
- an optical train for directing said excitation light from said light source at a substrate including a surface having fluorescently marked regions;
  - a translation system co-operatively arranged with said optical train and constructed to support and displace said substrate;
    - an auto-focusing system constructed and arranged to focus said excitation light onto said surface;
    - a detector for detecting fluorescent light from said fluorescently marked regions of said surface in response to said excitation light; and
  - a computer arranged to receive data from said detector corresponding to said detected fluorescent light of individual pixels of said surface and determine a dynamic range for data scaling; said computer being further arranged to scale said data and provide a data file representing an array of photon counts as a function of a pixel position on said surface.
- 21. The apparatus of claim 20, wherein said computer 25 is further arranged to scale said data using logarithmic scaling.
- 22. The apparatus of claim 21, wherein said computer is further arranged to generate an image file including data indicative of fluorescence intensity level as a function of said substrate pixel position.

- 23. The apparatus of claim 20, wherein said computer is further arranged to scale said data using linear scaling.
- 24. The apparatus of claim 23, wherein said computer is further arranged to generate an image file including data indicative of fluorescence intensity level as a function of said substrate pixel position.
- 25. The apparatus of claim 24, wherein said computer is arranged to control operation of said light source, said detector, said translation system and said auto-focusing system to execute auto-focusing by controlling said translation system and bringing into focus corners of said surface

- 26. The apparatus of claim 25, wherein said autofocusing system determines a focal plane of the light passing through said optical train.
- 27. The apparatus of claim 26, wherein said optical train separates reflected excitation light from said surface of the substrate from fluoresced light from said surface.